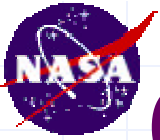


Project Planning and Estimation with Ask Pete



**Presented at the
26th Software Engineering Workshop
November 28, 2001**

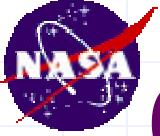
Tim Kurtz, ε Tim.Kurtz@grc.nasa.gov
SAIC/NASA Glenn Research Center
<http://tkurtz.grc.nasa.gov/pete>
Principal Investigator ε Phuoc Thai



Overview

- ◆ Overview
 - Who, What, When, How, Why
- ◆ How's It Work?
 - Methodologies
 - COCOMO II
 - Control Levels
 - IV&V Criteria
- ◆ Capabilities
- ◆ Reports
- ◆ Future Plans
- ◆ Summary





Overview

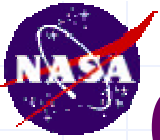
Who, What, When, How, Why?

Started life as the Software Project Expert System (SPES)

Pete is a computer application for:

- ◆ **P**rojects with software development
- ◆ **E**stimating duration, cost, schedule
- ◆ **T**ool for planning project, SPA and IV&V activities
- ◆ determining the **E**ffort (tasks) based on the COCOMO, SW reuse (COTS/GOTS), Control Levels, IV&V criteria and documentation





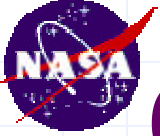
Overview

Who, **What**, When, How, Why?

Ask Pete incorporates:

- ◆ COCOMO II
- ◆ SLOC or Function Points
- ◆ GRC's Software Development Procedure & Control Levels
- ◆ NASA's IV&V Criteria
- ◆ Plan Templates
- ◆ CMM Checklist
- ◆ Advanced Risk Reduction Tool (ARRT) Tailoring

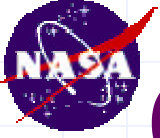




Overview

Who, What, **When**, How, Why?

1998	1999	2000	2001
Java interface	VB interface	Print, Save formatted report capability	CMM calculator
COCOMO & Control Levels	Versioning	SPA, Comparison, Responses, SDP reports	Function Points
Results report	Help system	Project properties	SDP template editor
	Distribution web site and statistics	Question comments	Link to ARRT risks
	User's Guide, Programmer's Manual	Integrated with ARRT	Added SQA metrics collection

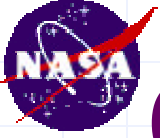


Overview

Who, What, When, **How**, Why?

The VB User Interface contains:

- ◆ Logic that
 - Manages the interface to the database
 - Generates tailored reports
 - Real-time cues that show the effects of tradeoffs
- ◆ Help system
- ◆ Links to the support web site and for email assistance



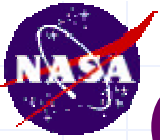
Overview

Who, What, When, **How** (cont.), Why?

An MS Access database contains:

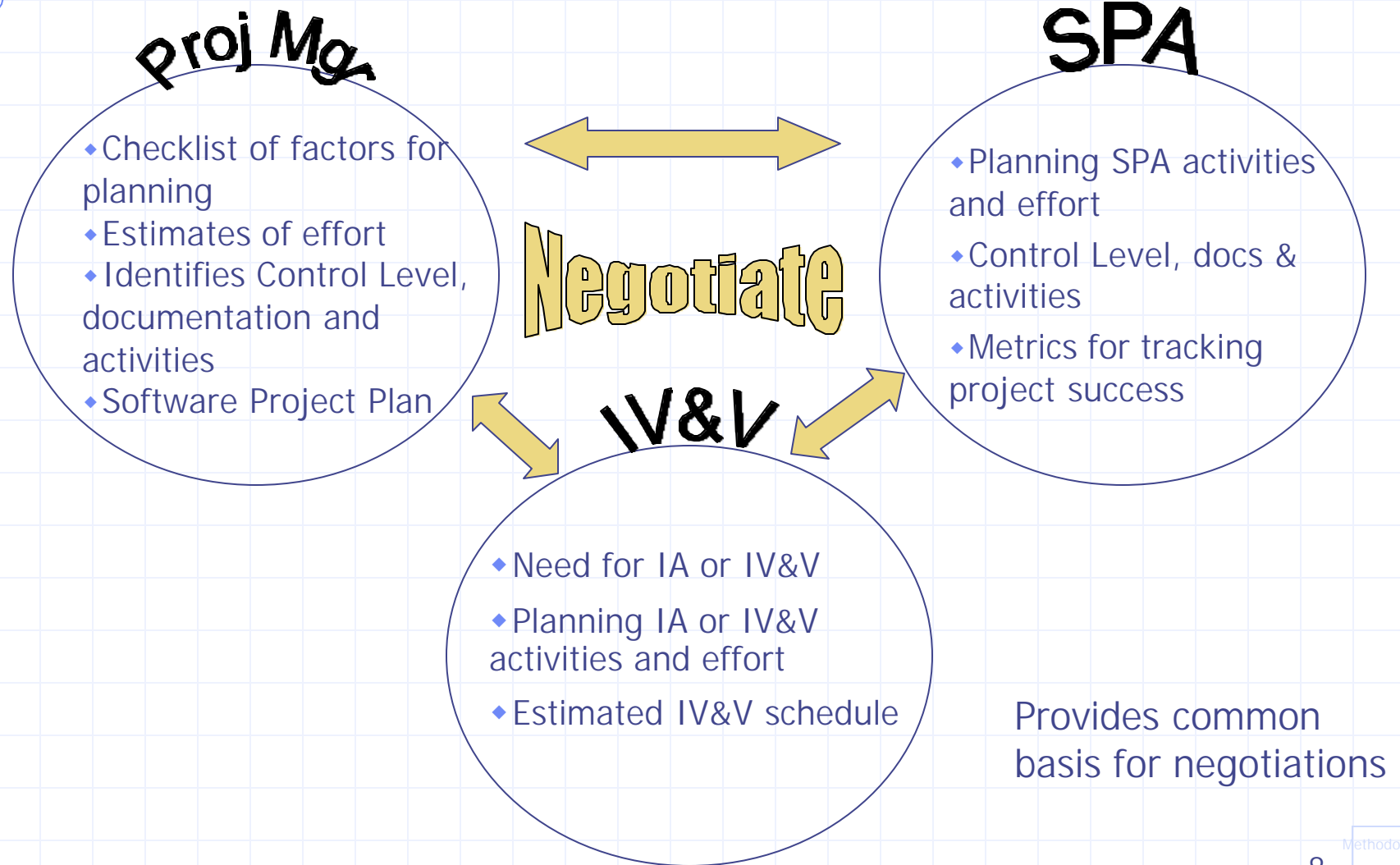
- ◆ All the questions
- ◆ And answers
- ◆ Project information
- ◆ The decision structure to determine
 - Cost and schedule estimates
 - Control Levels
 - Need for Independent Assessment (IA) or IV&V,
- ◆ Other report information

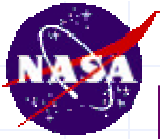




Capabilities

Who, What, When, How, **Why?**

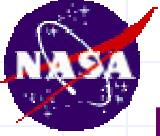




How's It Work

Methodologies

COCOMO II	Control Level	IV&V Criteria
Product	Resourcing	Consequences
<ul style="list-style-type: none">✓ Required reliability✓ Test data size✓ Complexity✓ Reusability requirement✓ Documentation requirements	<ul style="list-style-type: none">✓ Annualized cost	<ul style="list-style-type: none">✓ Personnel✓ Money and personnel✓ Mission success✓ Adverse publicity✓ Equipment✓ Effect on operations
Platform	Organizational Complexity	
<ul style="list-style-type: none">✓ Execution time✓ Storage✓ Platform volatility	<ul style="list-style-type: none">✓ Development locations✓ Customers✓ Developers experience	
Personnel	Technical Complexity	Likelihood
<ul style="list-style-type: none">✓ Analyst, programmer capability✓ Platform, applications experience✓ Language/tool experience✓ Personnel continuity	<ul style="list-style-type: none">✓ Test risk✓ Innovation✓ Development tool availability✓ Interdependency of deliverables	<ul style="list-style-type: none">✓ Team size✓ Use of contractors✓ Development location(s)✓ Schedule✓ CMM level✓ Innovation✓ Integration✓ Requirements stability✓ Amount of code
Project	Safety Implications	
<ul style="list-style-type: none">✓ Tool Usage✓ Multisite development✓ Required schedule	<ul style="list-style-type: none">✓ Potential damage✓ Potential injury	
	Business Implications	
	<ul style="list-style-type: none">✓ Consequence of failure✓ Schedule pressure	



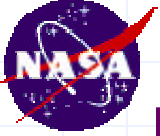
How's It Work

COCOMO II

Information derived from COCOMO II

- ◆ Size of project (SLOC)
 - Effects of Software Reuse
 - Effects of requirements creep
 - Function Points
- ◆ Schedule estimate
- ◆ Personnel requirements
- ◆ Estimated cost of development

Ref. Boehm, 1981. B. Boehm, *Software Engineering Economics*, Prentice Hall, Englewood Cliffs, NJ, 1981
Boehm, 2000. B. Boehm, *Software Cost Estimation with COCOMO II*, Prentice Hall, Englewood Cliffs, NJ, 2000
<http://sunset.usc.edu/research/COCOMOII/index.html>



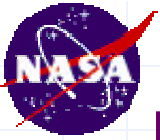
How's It Work

Control Levels

Information derived from Control Levels:

- ◆ Development lifecycle
- ◆ Development activities
- ◆ Documentation requirements

Ref. GRC P2.6.4 Implementation – Software Development, Rev. C,
<http://nasalivelink.grc.nasa.gov/livelink/livelink?func=ll&objId=241550&objAction=browsebmsfolder&sort=documentnumber>
LeR-M2.6.4 Glenn Research Center Software Development Manual, Rev B
<http://nasalivelink.grc.nasa.gov/livelink/livelink?func=ll&objId=834250&objAction=browse&sort=documentnumber>



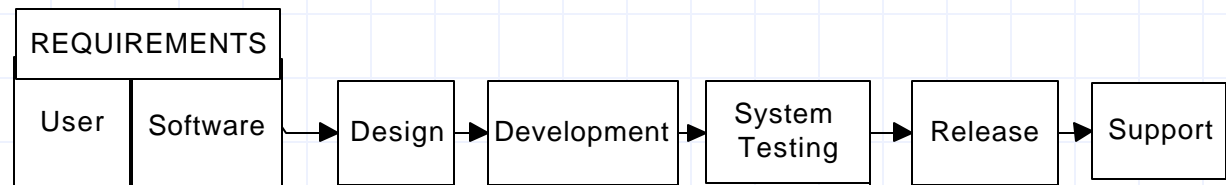
How's It Work

Control Levels

Software Control Levels

Critical/High Control Level
Medium Control Level
Low Control Level

CRITICAL/HIGH CONTROL PROCESS:

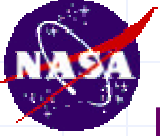


MEDIUM CONTROL PROCESS:



LOW CONTROL PROCESS:





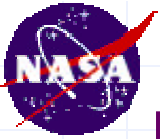
How's It Work

Control Levels

Control Level determine extent of the development activities that are performed in the following areas:

- Verification and validation
- CM and SQA
- Software safety
- Software risk management
- Software requirements
- Software inspections

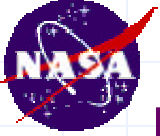




How's It Work

Control Levels

Pact Title	Low	Medium	High	Critical
Requirements	X	X	X	X
Authorization to proceed	X	X	X	X
Identify design/coding standards	X	X	X	X
Maintain Software Development Folder		X	X	X
Software Assurance reviews Management Plan		X	X	X
Implement Problem report and corrective action system		X	X	X
Management Plan approval	X	X	X	X
Documented requirements	X	X	X	X
Peer review of requirements		X	X	X
Conduct formal inspection of requirements				X
Software Assurance reviews requirements			X	X
Requirements approval	X	X	X	X
Peer review of plans			X	X
Implement Formal configuration management			X	X
Conduct Product Assurance Audits			X	X
Conduct Formal Review s			X	X
Document approval of requirements and formal review			X	X
Customer approval of certification procedures				X
Conduct analyses of criticality and safety				X
Plan and schedule IV&V activities				X
Identify method for verification of safety critical functions and requirements				X



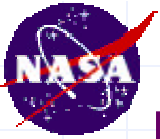
How's It Work

IV&V Criteria

Information derived from IV&V Criteria:

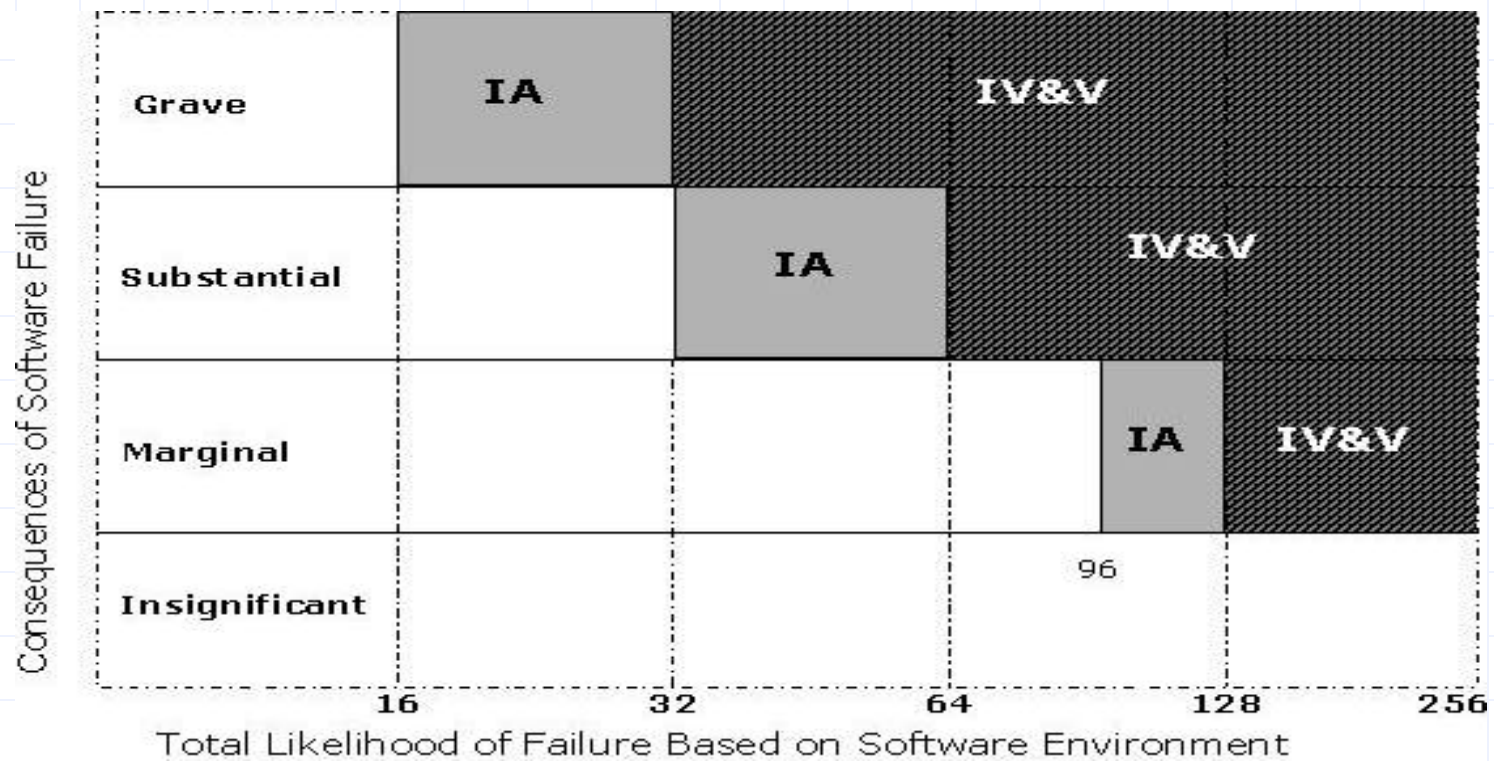
- ◆ Need for IV&V or Independent Assessment based on:
 - Consequences of failure
 - ◆ Grave
 - ◆ Substantial
 - ◆ Marginal
 - ◆ insignificant
 - Likelihood of failure
 - ◆ Range from 16 to 256
- ◆ IV&V and Independent Assessment Activities
 - If IA or IV&V indicated, a base set of activities are included in the recommended development activities

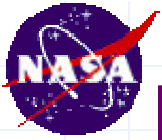
Ref. NPG 8730 Software Independent Verification and Validation (IV&V) Management, Rev. Draft



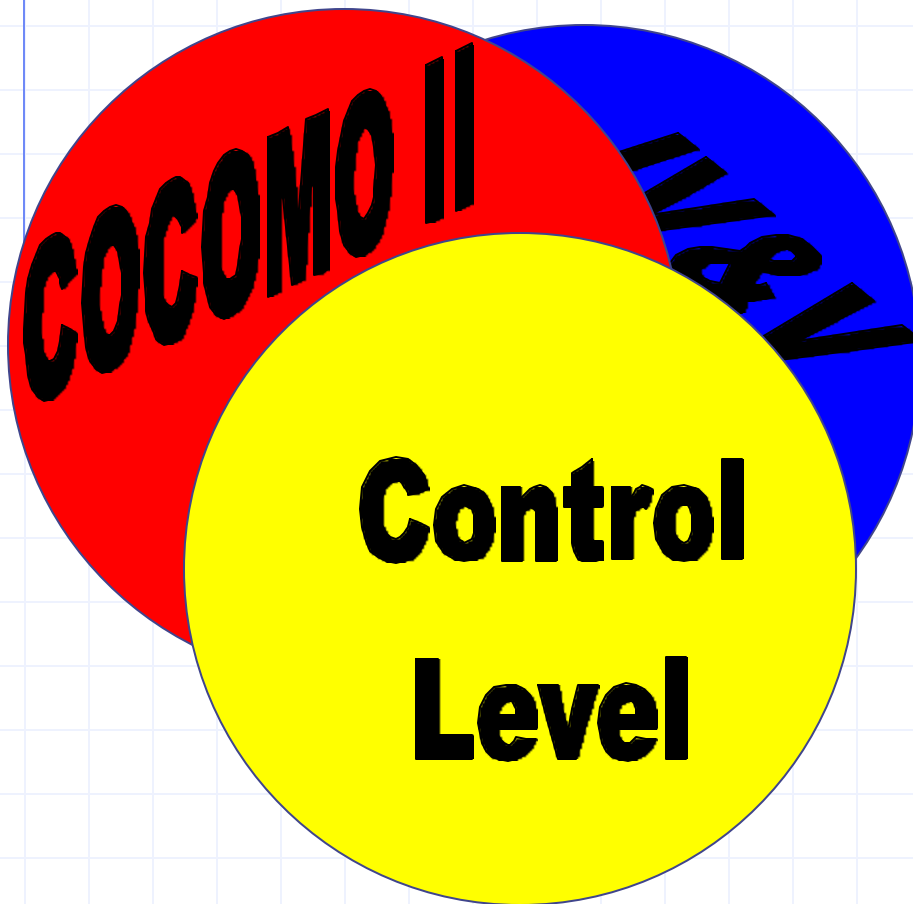
How's It Work

IV&V Criteria – IA/IV&V Determination

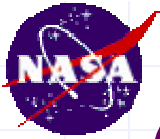




How's It Work



- ◆ COCOMO II factors address majority of the development planning issues
- ◆ Control Level factors overlap COCOMO II and address additional organizational and performance issues
- ◆ Incorporating other areas of interest, (i.e. IV&V, Software Assurance), build on COCOMO II and Control level questions



Capabilities Characterize Projects

Ask Pete 4.0
File Project Tools Window Help

Project: zClass, ver. 0

Is this program interactive?

Legend:
● Answered
● Not Answered
● Not Applicable

Questions: Total: Answered:

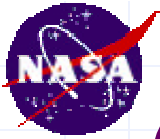
zClass

- COCOMO
- Control Level
- Control Level and COCOMO
- IV&V
- Reuse
- SLOC
- **SW, Docs and Activities**
 - 1) Will Off-The-Shelf software be used?
 - **2) Is this program interactive?**
 - 3) Is safety an issue with this project?
 - 4) Is security or privacy an issue with this project?
 - 5) Is certification required?
 - 6) Will existing software components be reused (including COTS/GOTS)?

Comment:

Status: Control Level: Unknown COCOMO Sched: Unknown COCOMO Cost: Unknown KSLOC: Unknown

Control Level: Unknown COCOMO Sched: Unknown COCOMO Cost: Unknown KSLOC: Unknown



Capabilities

Project Properties

Properties

Project Info Contacts Description

General Summary IV&V

Project: zGus
Version: 4

Created: 10/12/2001 4:59:26 PM
Modified: 10/12/2001 5:12:36 PM
Accessed: 10/15/2001 4:08:54 PM

Printed:

OK Cancel

Properties

Project Info Contacts Description

General **Summary** IV&V

Author:
Manager:
Company:
Category:
Keywords:
Comments:
Based on version 2 of the project. ***** Based on versi

OK Cancel

Properties

Project Info Contacts Description

General Summary **IV&V**

Level of IV&V

☐ Basic ☐ Independent Assessment
☐ Limited
☐ Focused
☐ Comprehensive Clear all

OK Cancel

Properties

General Summary IV&V

Project Info Contacts Description

Development Organization:
Project Identification:
Programming Language:
Development Specifications:
ISO 12207
ISO 9001

Add Spec Remove Spec

OK Cancel

Properties

General Summary IV&V

Project Info **Contacts** Description

Project Lead: Phone #:
Software Lead:
SQA:
Configuration Management:
PI/Customer POC:

OK Cancel

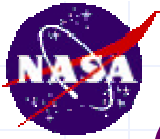
Properties

General Summary IV&V

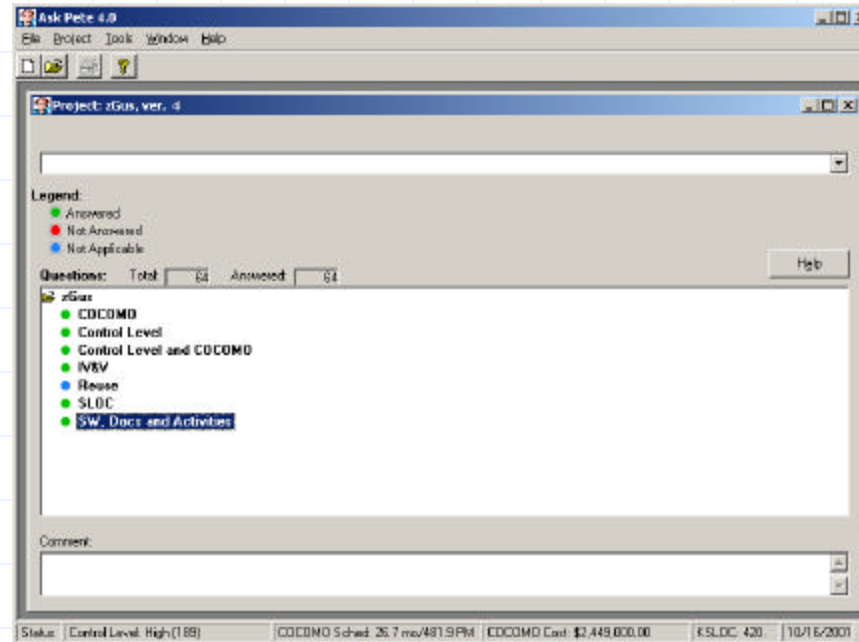
Project Info Contacts **Description**

Project Description:

OK Cancel



Capabilities Characterized Project

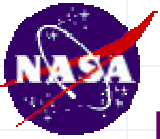


Control Level: High (189)

COCOMO Sched: 26.7 mo/481.9 PM

KSLOC: 420.

COCOMO Cost: \$2,449,000.00



Reports

Software Development Plan

Project: zGus Software Development Plan

SOFTWARE DEVELOPMENT PLAN (SDP)

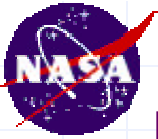
FOR THE
|
zGus

Document Identifier
VERSION x.x

Date

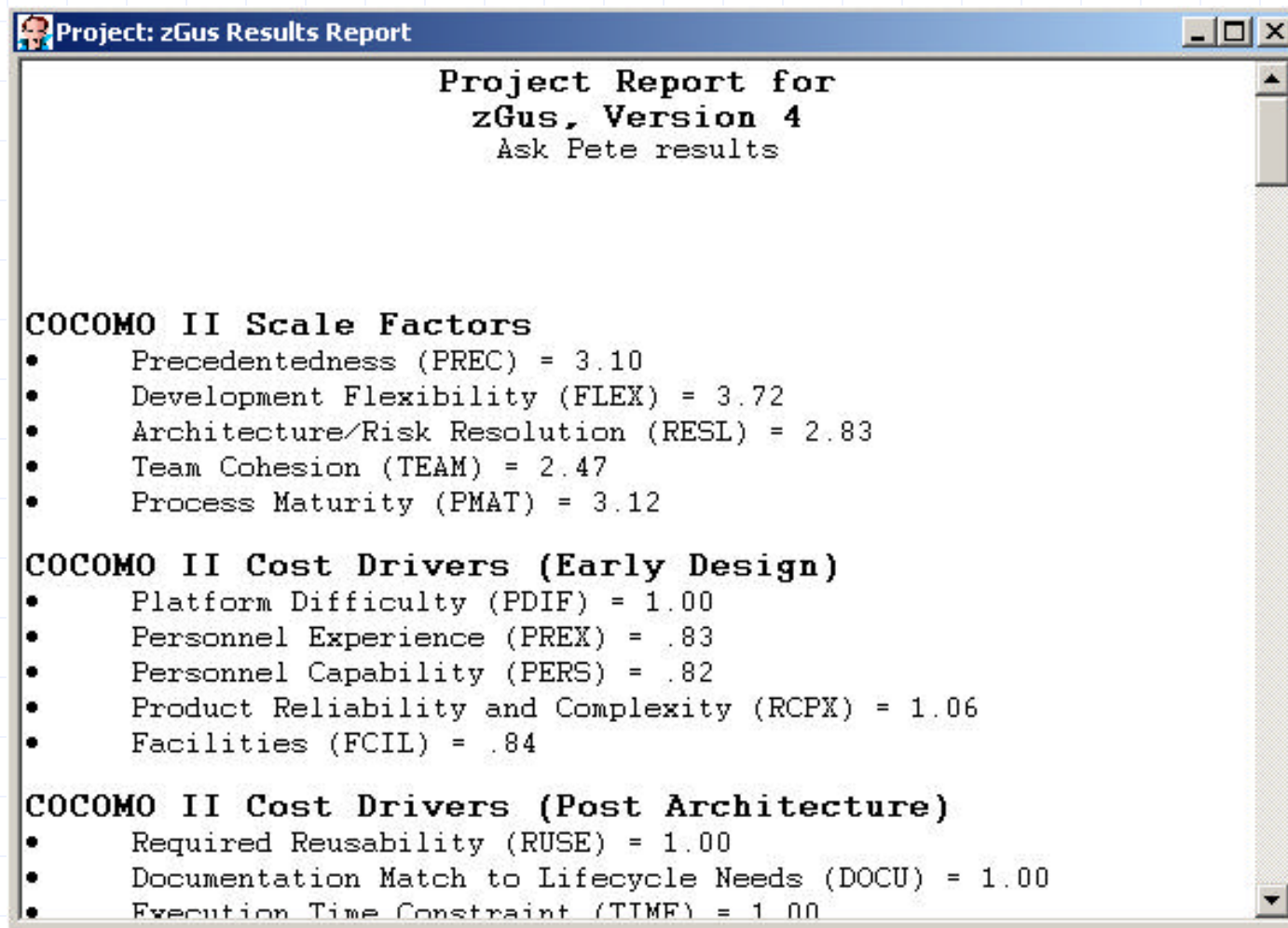
Prepared By:
|ORG|

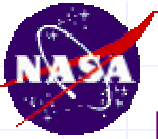
Reviewed by:



Reports

Results Report – COCOMO II Factors





Reports

Results Report – SLOC Estimate, Control Level

```
Project: zGus Results Report

COCOMO II Variables
Size = 420000.00

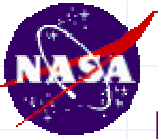
COCOMO II Subtotals
• Scale Factors = 15.23
• B = 1.06
• Effort Multipliers = .27

COCOMO II Estimate
This project will require 481.90 person months to accomplish.

Caveat
This implementation of COCOMO II cannot be guaranteed to provide
results that are consistent with the latest USC COCOMO II model, as
some parts of this have not been fully implemented.

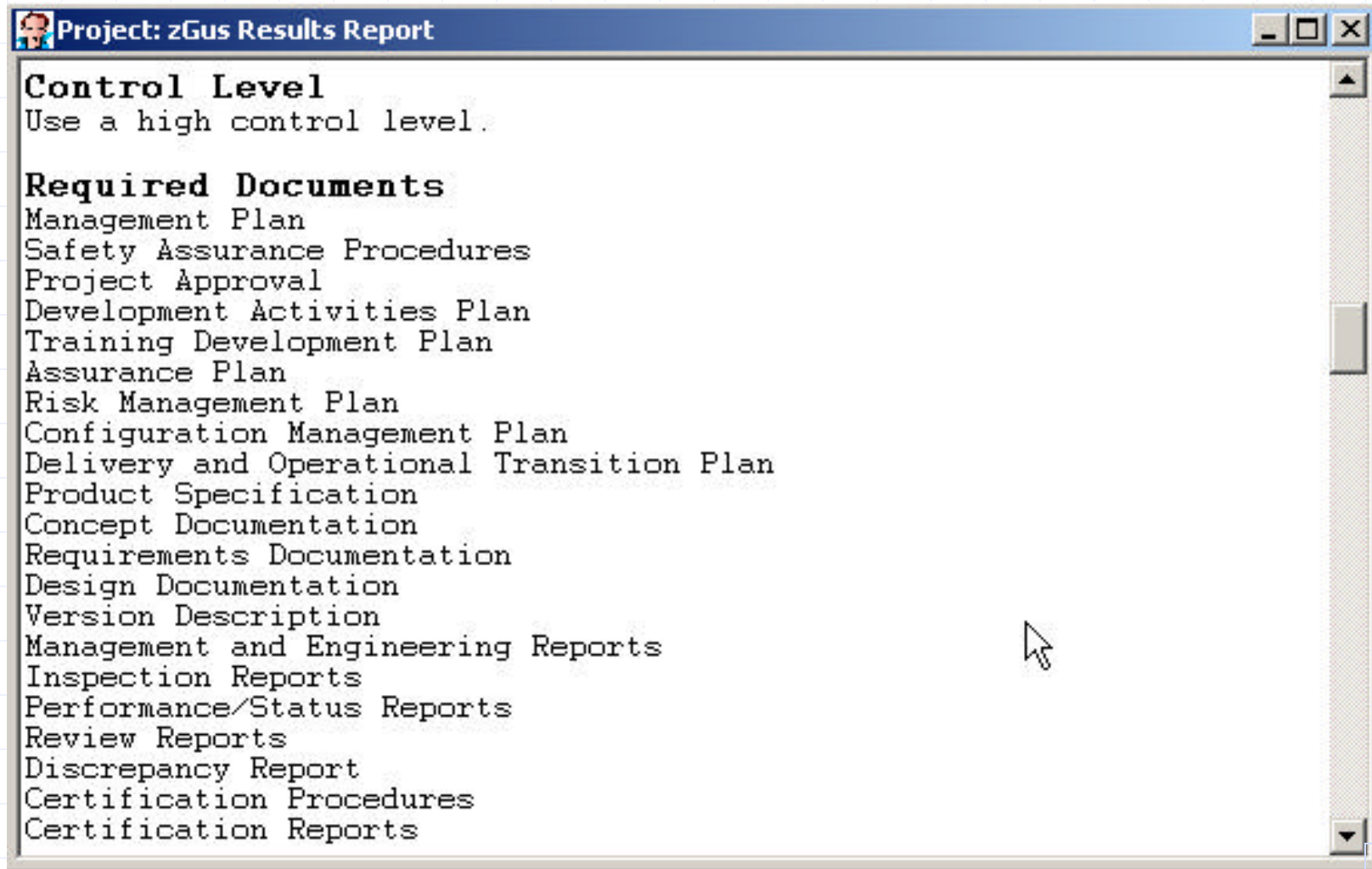
DERA Sizing Score
• Control Level = 189.00
• DERA = 160.00

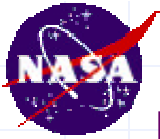
Control Level
Use a high control level.
```

Reports

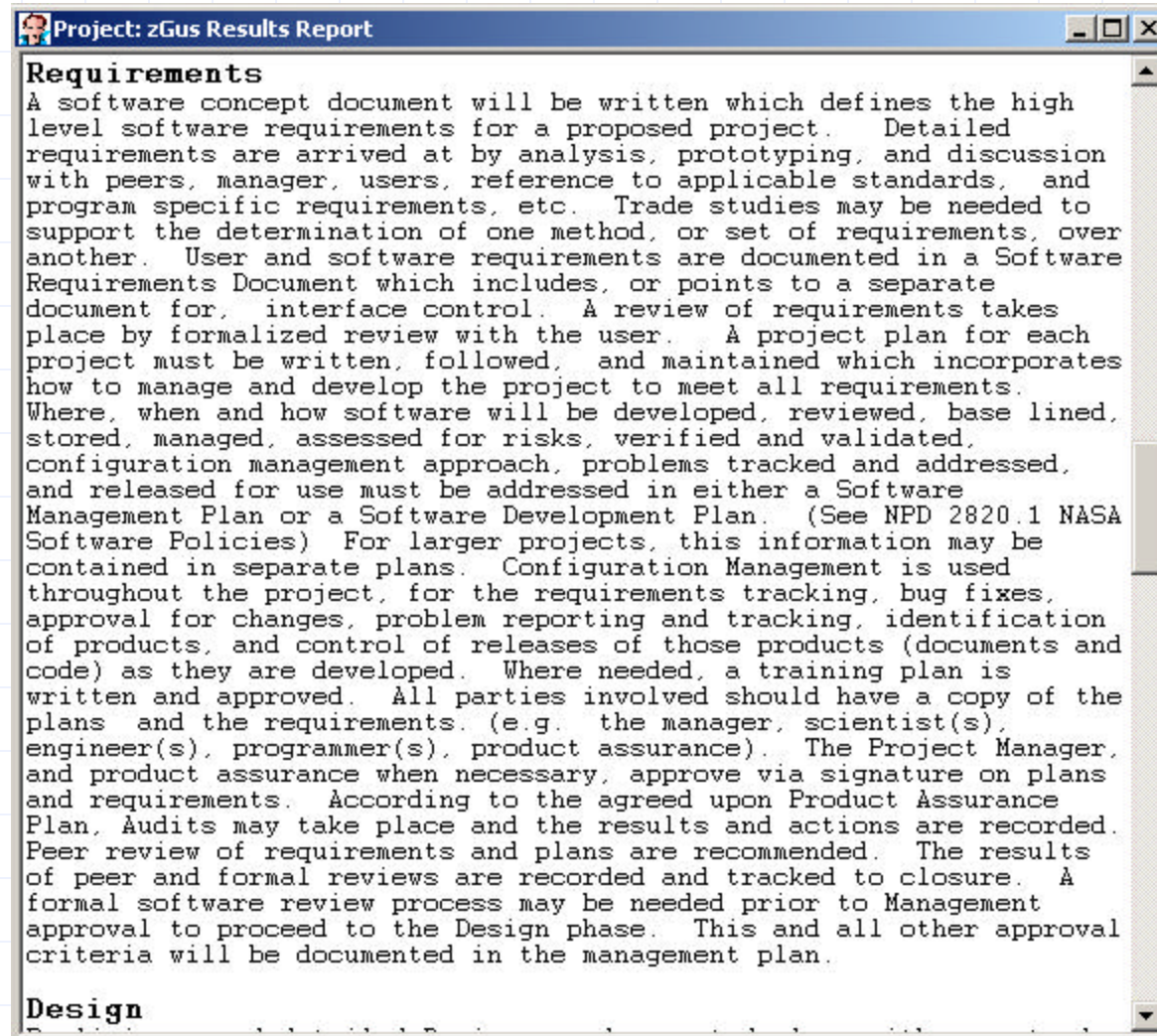
Results Report – Recommended Documents

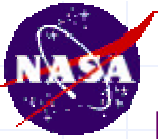




Reports

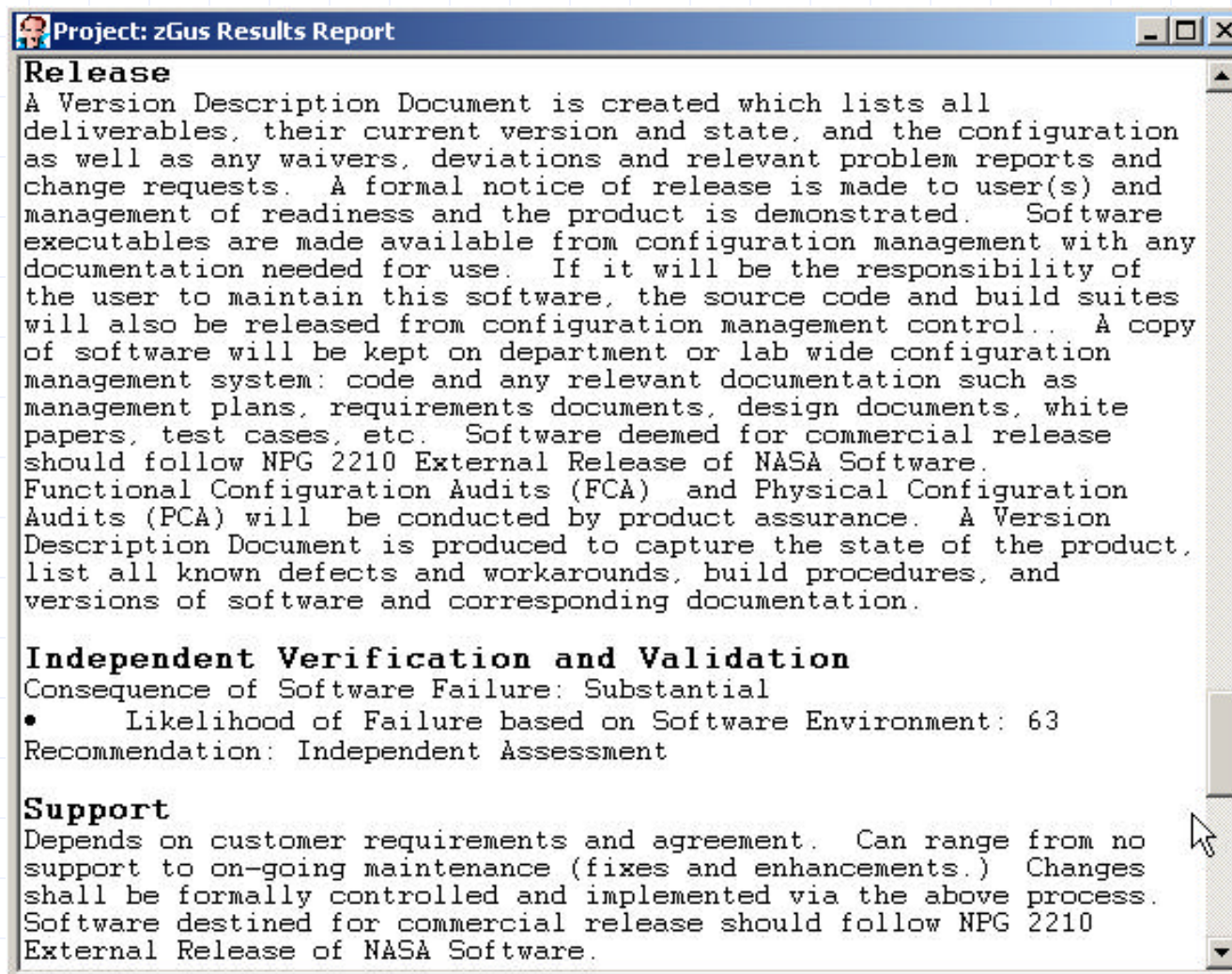
Results Report – Phase Activities

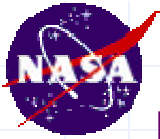




Reports

Results Report – IV&V Recommendation





Reports

Results Report – COCOMO II Phase Estimate

```
Project: zGus Results Report

Phase Estimates
NOTE: The COCOMO calculation does not include estimates for the Plans
and Requirements phase. An assumption has been made for the
following results that the Plans and Requirements phase is equal to
7% of the effort and schedule of the Product Design, Programming, and
Integration and Test phases. Because this assumption is not part of
the calculated COCOMO II result, it is not included in the totals at
the end of this section or in the figures shown on the status bar.
The information provided here is based on a typical project and has
not been optimized for zGus~004. It should be used as a guide only
for developing initial staffing and schedule estimates.

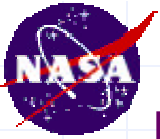
Estimate for total development effort = 26.7 months.
The schedule breaks down as follows:
  Plans and Requirements
    33.7 PM
    5.7 mo.
    5.9 FTE

  Product Design
    81.9 PM
    7.4 mo.
    11.1 FTE

  Programming
    254.1 PM
    Detailed Design: 112. PM
    Code & Unit Test: 142.1 PM
    10.9 mo.
    23.2 FTE

  Integration and Test
    145.9 PM
    8.4 mo.
    17.5 FTE

  Project Totals
    Total Effort: 481.9 PM
    Total Schedule: 26.7 mo.
    Average Staffing: 18. FTE
```



Reports

SPA Report

Project: zGus SPA Waterfall Model Phase Plan

Software Product Assurance
Planning Estimates by Control Level Phase for
zGus
Oct 16, 2001

1.0 PROJECT INTRODUCTION AND OVERVIEW

1.1 Contractor
(Enter developing contractor or group name)

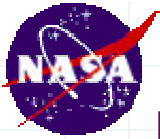
1.2 Contract
(Enter development contract or DO or other identifying number if applicable)

1.3 SLOC Count
420,000

1.4 Control Level
High Control

1.5 Languages
(Programming languages)

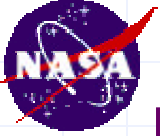
Text in parentheses replaced by project properties information if available



Reports

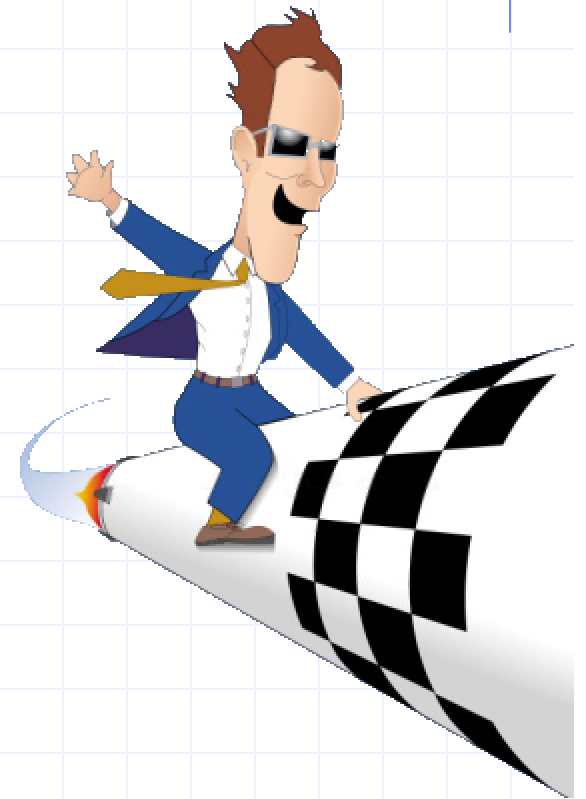
SPA Report

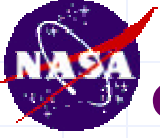
Project: zGus SPA Waterfall Model Phase Plan	
A. REQUIREMENTS TASKS	
Process Evaluations	Hours
Planning	188.50
Risk Management	50.25
Requirements Mgmt.	503.00
CM	42.00
CA	42.00
QA	101.00
Activity Evaluations	Hours
Data Collection & Analysis	84.00
Process Improvement	50.25
Review Participation	326.50
Team Participation	50.25
Product Evaluations	Hours
Development Plan	62.00
Assurance Plan	26.25
Sys/SubSys Spec	700.75
SW Req Spec	700.75
Interface Req Spec	351.25
Total Hrs for this Phase	3278.75



Future Plans

- ◆ Develop and provide training and informational presentations at NASA centers, conferences
- ◆ Develop and finalize plan templates (SQA, SDP)
- ◆ Implement ability to decompose/combine projects
- ◆ Investigate conversion to web-based application





Summary

- ◆ Answered Who, What, Where, When, How and Why?
- ◆ Training sessions and presentations at NASA Centers next year
- ◆ Incorporates COCOMO II, (tailorable) Control Levels and IV&V criteria
- ◆ Overview of the program and reports
- ◆ Download your copy from <http://tkurtz.grc.nasa.gov/pete>

